Exercise - I (Conceptual Questions) Build Up Your Understanding

NUCLEAR PHYSICS

1. Let F_{pp}, F_{pn} and F_{nn} denote the nuclear force between proton–proton, proton–neutron and neutron–neutron pair respectively. When separation is 1 fm :-
(1) $F_{pp} < F_{pn} = F_{nn}$ (2) $F_{pp} > F_{pn} = F_{nn}$
(3) $F_{pp} = F_{pn} = F_{nn}$ (4) $F_{pp} < F_{pn} < F_{nn}$

2. A nuclear fission is given below
$A^{240} \rightarrow B^{100} + C^{140} + Q(\text{energy})$
Let binding energy per nucleon of nucleus A, B and C is 7.6 MeV, 8.1 MeV and 8.1 MeV respectively. Value of Q is :-(Approximately)
(1) 20 MeV (2) 220 MeV
(3) 120 MeV (4) 240 MeV

3. How much energy will be released when 10 kg of U^{235} is completely converts into energy :-
(1) 5×10^{27} MeV (2) 5×10^{24} MeV
(3) 9×10^{17} J (4) All of these

4. How much energy is released when 2 mole of U^{235} is fissioned :-
(1) 10^{24} MeV (2) 24×10^{25} MeV
(3) 10^{24} J (4) 10^{24} kWh

5. As the mass number increases, binding energy per nucleon :-
(1) increases
(2) decreases
(3) remains same
(4) may increase or may decrease

6. Possible forces on a proton by a proton in a nucleus is/are :-
(1) Coulomb force (2) Nuclear force
(3) Gravitational force (4) All of these

7. The energy radiated by a red giant star produces by :-
(1) Fission process
(2) Fusion process
(3) Chemical burning of hydrogen
(4) Gravitational contraction

8. In the process of atomic explosion, the most of fission energy is released in the form of :–
(1) γ - rays
(2) Kinetic energy of products
(3) Infra red rays
(4) Visible light

9. Which of the following nucleus is fissionable by slow neutrons :-
(1) $_{92}U^{238}$ (2) $_{93}Np^{239}$
(3) $_{92}U^{235}$ (4) $_{2}He^{4}$

10. The example of nuclear fusion is .
(1) formation of barium and krypton from uranium
(2) formation of helium from hydrogen
(3) formation of plutonium –235 from uranium –235
(4) formation of water from hydrogen and oxygen

11. Electron - positron pair can be created by γ-rays. In this process the minimum energy of γ-rays should be :-
(1) 5.0 MeV (2) 4.02 MeV
(3) 15.0 MeV (4) 1.02 MeV

12. For nuclear reaction :
$_{92}U^{235} + {}_{0}n^{1} \rightarrow {}_{56}Ba^{144} + \ldots\ldots\ldots + 3\ {}_{0}n^{1}$
(1) $_{26}Kr^{89}$ (2) $_{36}Kr^{89}$
(3) $_{26}Sr^{90}$ (4) $_{38}Sr^{89}$

13. For the given reaction, the particle X is -
$_{6}C^{11} \rightarrow {}_{5}B^{11} + \beta^{+} + X$
(1) Neutron (2) Anti neutrino
(3) Neutrino (4) Proton

14. In a breeder reactor, useful fuel obtained from U^{238} is :
(1) Ac^{233} (2) Th^{238}
(3) U^{235} (4) Pu^{239}

15. Boron used in Atomic Reactor for:-
(1) absorbption of neutrons
(2) absorbption of α - particles
(3) speed up the reaction
(4) change the reaction

16. Who discovered the nuclear fission :-
(1) Otto Hahn and strassman
(2) Fermi
(3) Baithe
(4) Rutherford

17. Which one is best neutron moderator in all respects:
(1) Barium oxide (2) Water
(3) Graphite (4) Heavy water

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18. X(n, α) $^{7}_{3}Li$, then the element X will be :–
(1) $^{10}_{5}B$ (2) $^{9}_{5}B$ (3) $^{11}_{4}Be$ (4) $^{4}_{2}He$

19. M_n and M_p represent the mass of neutron and proton respectively. An element having nuclear mass M has N neutrons and Z-protons, then the correct relation will be :-
(1) $M<\{N.M_n+Z.M_p\}$ (2) $M>\{N.M_n+Z.M_p\}$
(3) $M=\{N.M_n+Z.M_p\}$ (4) $M=N\{M_n + M_p\}$

20. Energy is released in nuclear fission is due to
(a) Few mass is converted into energy
(b) Total binding energy of fragments is more than the B.E. of parental element
(c) Total B.E. of fragments is less than the B.E. of parental element
(d) Total B.E. of fragments is equals to the B.E. of parental element is
(1) a,c (2) a,b (3) a,d (4) All

21. Energy in an atom bomb is produced by the process of :
(1) nuclear fusion
(2) nuclear fission
(3) combination of hydrogen atoms
(4) combination of electrons and protons

22. Assuming that 200 MeV of energy is released per fission of $_{92}U^{235}$ atom. Find the number of fission per second required to release 1 kW power :-
(1) 3.125×10^{13} (2) 3.125×10^{14}
(3) 3.125×10^{15} (4) 3.125×10^{16}

23. 1 a.m.u. (1.66×10^{-27} kg) is equal to
(1) 139 MeV/c^2 (2) 39 MeV/c^2
(3) 93 MeV/c^2 (4) 931 MeV/c^2

24. In nuclear fission the percentage of mass converted into energy is about :-
(1) 0.1% (2) 1%
(3) 10% (4) 0.01%

25. Which of the following are suitable for the fusion process :-
(1) Light nuclei
(2) heavy nuclei
(3) Element must be lying in the middle of the periodic table
(4) Middle elements, which are lying on binding energy curve

26. Which one of the following particle is unstable?
(1) α-particle (2) electron
(3) proton (4) neutron

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27. Which of the following is weakest force :-
(1) Gravitational force
(2) Electric force
(3) Magnetic force
(4) Nuclear force

28. The volume occupied by an atom is greater than the volume of the nucleus by a factor of about :-
(1) 10^1 (2) 10^5 (3) 10^{10} (4) 10^{15}

29. The mass of proton is 1.0073 u and that of neutron is 1.0087 u (u = atomic mass unit). The binding energy of $_2{}^4He$ is :-
(1) 0.0305 J (2) 0.0305 erg
(3) 28.4 MeV (4) 0.061 u
(Given:- mass of helium nucleus 4.0015 u)

30. The mass number of a nucleus is
(1) always less than its atomic number
(2) always more than its atomic number
(3) may equal to its atomic number
(4) sometimes less than and sometimes more than its atomic number

31. In the following reaction X is :–
$_{20}Ca^{40} + X \rightarrow {}_{21}Sc^{43} + {}_{1}H^{1}$
(1) Electron (2) Positron
(3) alpha particle (4) Proton

32. Nuclear fusion is possible :–
(1) only between light nuclei.
(2) only between heavy nuclei.
(3) between both light and heavy nuclei.
(4) only between nuclei which are stable against β–decay.

33. The order of nuclear density is
(1) 10^{13} kg/m^3 (2) 10^{15} kg/m^3
(3) 10^{17} kg/m^3 (4) 10^{19} kg/m^3

34. Two light nuclei of masses m_1 and m_2 are fused to form a more stable nucleus of mass m_3 then:-
(1) $m_3 = |m_1 - m_2|$ (2) $m_3 < (m_1 + m_2)$
(3) $m_3 > (m_1 + m_2)$ (4) $m_3 = m_1 + m_2$

35. A nucleus represented by the symbol $^{A}_{Z}X$ has :-
(1) Z protons and A – Z neutrons
(2) Z protons and A neutrons
(3) A protons and Z – A neutrons
(4) Z neutrons and A – Z protons

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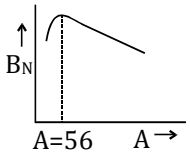
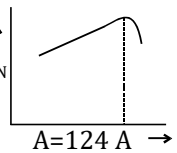
36. M_p denotes the mass of a proton and M_n that of a neutron. A given nucleus, of binding energy B, contains Z protons and N neutrons. The mass M (N, Z) of the nucleus is given by (c is velocity of light) :-
(1) $M(N, Z) = NM_n + ZM_p + Bc^2$
(2) $M(N, Z) = NM_n + ZM_p - B/c^2$
(3) $M(N, Z) = NM_n + ZM_p + B/c^2$
(4) $M(N, Z) = NM_n + ZM_p - Bc^2$

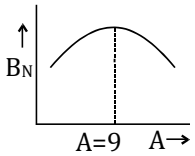
37. Mass equivalent to energy 931 MeV is
(1) 6.02×10^{-27} kg (2) 1.66×10^{-27} kg
(3) 16.66×10^{-26} kg (4) 6.02×10^{-26} kg

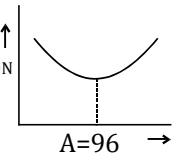
38. One milligram of matter converted into energy will give
(1) 9 J (2) 9×10^{13} J
(3) 9×10^{5} J (4) 9×10^{10} J

39. Force acting on proton-proton inside a nucleus is–
(1) Nuclear force > electric force
(2) Electric force > Nuclear force
(3) Gravitational force > Nuclear force
(4) None of the above

40. The dependence of binding energy per nucleon (B_N) on the mass number (A), is represented by
(1) 

(2) 

(3) 

(4) 

41. Which one of the following pairs of nuclei are isotones :-
(1) $_{34}Se^{74}$, $_{31}Ga^{71}$ (2) $_{38}Sr^{84}$, $_{38}Sr^{86}$
(3) $_{42}Mo^{92}$, $_{40}Zr^{92}$ (4) $_{20}Ca^{40}$, $_{16}S^{32}$

42. Which one of the following is a possible nuclear reaction :-
(1) $^{10}_{5}B + {}^{4}_{2}He \longrightarrow {}^{13}_{7}N + {}^{1}_{1}H$
(2) $^{23}_{11}Na + {}^{1}_{1}H \longrightarrow {}^{22}_{10}Ne + {}^{4}_{2}He$
(3) $^{239}_{93}Np \longrightarrow {}^{239}_{94}Pu + \beta^- + \bar{\nu}$
(4) $^{11}_{7}N + {}^{1}_{1}H \longrightarrow {}^{12}_{6}C + \beta^- + \nu$

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43. In the reaction $^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$. If the binding energies of $^{2}_{1}H$, $^{3}_{1}H$ and $^{4}_{2}He$ are respectively a, b and c (in MeV), then the energy (in MeV) released in this reaction is
(1) a + b + c (2) c + a – b
(3) c – a – b (4) a + b + c

44. In any fission process the ratio $\frac{\text{mass of fission products}}{\text{mass of parent nucleus}}$ is –
(1) Greater than 1
(2) Depends on the mass of the parent nucleus
(3) Equal to 1
(4) Less than 1

45. Fission of nuclei is possible because the binding energy per nucleon in them –
(1) Decreases with mass number at low mass numbers.
(2) Increases with mass number at low mass numbers.
(3) Decreases with mass number at high mass numbers.
(4) Increases with mass number at high mass numbers.

46. The main function of moderators in nuclear reactors is to :-
(1) decrease the energy of neutrons
(2) absorb the extra neutrons
(3) provide shield from nuclear radiations
(4) provide cooling

RADIOACTIVITY

47. Probability of survival of a radioactive nucleus in one mean life is :-
(1) $\frac{1}{2}$ (2) $\frac{1}{e}$ (3) $\frac{1}{4}$ (4) $\frac{1}{5}$

48. Ratio of initial active nuclei in two different samples is 2 : 3. Their half lives are one hour and two hours respectively. Ratio of active nuclei at the end of 6 hours will be :-
(1) 1 : 1 (2) 1 : 12 (3) 4 : 3 (4) 3 : 4

49. Atomic weight of a radioactive element is M_w gram. Radioactivity of m gram. of its mass is :–
(N_A = Avogadro number, λ = decay constant)
(1) $N_A \lambda$ (2) $\left(\frac{N_A}{M_w} m\right)\lambda$
(3) $\left(\frac{N_A}{m}\right)\lambda$ (4) $\left(\frac{N_A}{m} M_w\right)\lambda$

50. Which spectrum is continuous
(1) α–rays (2) β–rays
(3) γ–rays (4) All of these

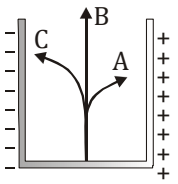
51. Which statement about radioactive radiations is true
(1) Speed of α-particles is a characteristic property.
(2) Speed of β-particles is a characteristic property.
(3) Speed of γ-photon is a characteristic property.
(4) All of these.

52. Which one moves with greatest speed :-
(1) α-rays (2) β–rays
(3) γ–rays (4) cathode rays

53. For a radioactive sample, at given instant, number of active nuclei is N and its decay constant is λ then the incorrect relation is–
(1) Nλ = activity at given instant.
(2) λ = decay probability per unit time for a nucleus
(3) After the next $\frac{1}{\lambda}$ time interval, active nuclei in the sample will be $N\left(1-\frac{1}{e}\right)$
(4) The half life of the sample = $\frac{\ell n2}{\lambda}$

54. If a nucleus is emitting e^- particle, its neutron to proton ratio (n/p) will :–
(1) Increase.
(2) Decrease
(3) Remain unchanged
(4) Can't be determined.

55. A radioactive source is kept in an uniform electric field α, β and γ- particle are emitting. α,β,γ are respectively :-



(1) A,B,C (2) A,C,B (3) C,A,B (4) C,B,A

56. The rate of disintegration of a radioactive sample can be increased by :-
(1) Increasing the temperature
(2) Increasing the pressure
(3) Chemical reaction
(4) It is not possible

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57. In a radioactive decay, neither the atomic number nor the mass number changes. Which of the following would be emitted in the decay process.
(1) Proton (2) Neutron
(3) Electron (4) Photon

58. At some instant two radioactive substance are having amount in ratio of 2 : 1. Their half lives are 12 hrs and 16 hrs then after two days the ratio of their quantities is
(1) 1 : 1 (2) 2 : 1 (3) 1 : 2 (4) 1 : 4

59. The isotope used for curing the cancer is :
(1) K (40) (2) Co (60)
(3) Sr (90) (4) I (131)

60. 'Rn' decays into 'Po' by emitting α-particle with half life of 4 days. A sample contains 6.4×10^{10} atoms of Rn. After 12 days, the number of atoms of 'Rn' left in the sample will be-
(1) 3.2×10^{10} (2) 0.53×10^{10}
(3) 2.1×10^{10} (4) 0.8×10^{10}

61. Neutrino is a particle, which is :
(1) charged like an electron and has no spin
(2) chargeless and has spin
(3) chargeless and has no spin
(4) charged like an electron and has spin

62. A radioactive element ${}_{90}X^{238}$ decays in to ${}_{83}Y^{222}$. The number of β - particles emitted is:
(1) 2 (2) 4 (3) 6 (4) 1

63. The relation between λ and $T_{1/2}$ as :-
($T_{1/2} \rightarrow$ half life, $\lambda \rightarrow$ decay constant)
(1) $T_{1/2} = \frac{\ell n2}{\lambda}$ (2) $T_{1/2}\, \ell n2 = \lambda$
(3) $T_{1/2} = \frac{1}{\lambda}$ (4) $(\lambda + T_{1/2}) = \frac{\ell n2}{2}$

64. The half life of a radioactive material is 5 years. The probability of disintegration for a nucleus in 10 years is :-
(1) 0.50 (2) 0.25
(3) 0.60 (4) 0.75

65. 10.24 g radioactive substance has half life 3.8 days. After 19 days, its remaining quantity is :-
(1) 0.151 g (2) 0.32 g
(3) 1.51 g (4) 0.16 g

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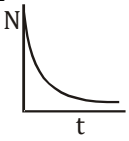
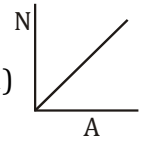
66. A radioactive reaction is $_{92}U^{238} \rightarrow {}_{82}Pb^{206}$. How many α and β particles are emitted ?
(1) 10α, 6β
(2) 4 proton, 8 neutron
(3) 6 electron, 8 proton
(4) 6β, 8α

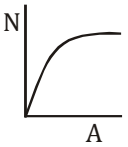
67. Which rays contain (+ Ve) charged particle:–
(1) α–rays (2) β–rays
(3) γ–rays (4) X–rays

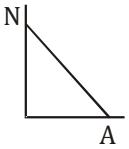
68. Half life of radioactive element is 12.5 Hour and its quantity is 256 gram. After how much time its quantity will remain 1 gram :–
(1) 50 Hrs (2) 100 Hrs
(3) 150 Hrs (4) 200 Hrs

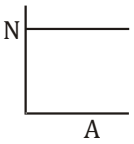
69. The number of undecayed nuclei N in a sample of radioactive material as a function of time is shown in the graph.
Which of the following graph correctly shows the relationship between N and the activity A ?



(1) 

(2) 

(3) 

(4) 

70. A sample of radioactive element containing 4×10^{16} active nuclei. Half life of element is 10 days, then number of decayed nuclei after 30 days :-
(1) 0.5×10^{16} (2) 2×10^{16}
(3) 3.5×10^{16} (4) 1×10^{16}

71. When $_{90}Th^{238}$ changes into $_{83}Bi^{222}$, then the number of emitted α and β-particles are :-
(1) 8α, 7β (2) 4α, 7β
(3) 4α, 4β (4) 4α, 1β

72. A radioactive nucleus decay as follows :-
$X \xrightarrow{\alpha} X_1 \xrightarrow{\beta} X_2 \xrightarrow{\alpha} X_3 \xrightarrow{\gamma} X_4$,
if the atomic number and the mass number of X are 72 and 180 then the mass number and atomic number of X_4 are :-
(1) 172, 70 (2) 171, 69
(3) 172, 69 (4) 172, 68

73. The decay constant of a radioactive sample is λ. The respective values of its half life and mean life are :-
(1) $\frac{1}{\lambda}$ and $(\log_e 2)$ (2) $\frac{\log_e 2}{\lambda}$ and $\frac{1}{\lambda}$
(3) $\lambda(\log_e 2)$ and $\frac{1}{\lambda}$ (4) $\frac{2}{\lambda}$ and $\frac{1}{\lambda}$

74. In a mean life of a radioactive sample :-
(1) About 1/3 of substance disintegrate
(2) About 2/3 of substance disintegrate
(3) About 90% of the substance disintegrate
(4) Almost all the substance disintegrates

75. Activity of a radioactive element is 10^3 dps. Its half life is 1 second. After 3 seconds, its activity will be (dps = decay per second) :-
(1) 1000 dps (2) 250 dps
(3) 125 dps (4) None of these

76. A sample of radioactive element has a mass of 10 gram at an instant t = 0. The approximate mass of this element in the sample after two mean lives is :-
(1) 1.35 gram (2) 2.50 gram
(3) 3.70 gram (4) 6.30 gram

77. Which of the following ray are **not** electromagnetic waves :-
(1) X-rays (2) γ-rays
(3) β-rays (4) Heat rays

78. A radioactive substance decays to $1/16^{th}$ of its initial activity in 40 days. The half–life of the radioactive substance expressed in days is :–
(1) 2.5 (2) 5 (3) 10 (4) 20

79. A nuclear reaction given by
$_ZX^A \rightarrow {}_{Z+1}Y^A + {}_{-1}e^0 + \bar{\nu}$ represents.
(1) β-decay (2) γ-decay
(3) fusion (4) fission

80. If half-life of a radioactive substance is 60 minutes, then the percentage decay in 4 hours is :
(1) 50% (2) 71%
(3) 85% (4) 93.7%

81. The active amount of radioactive substance left after one hour whose half life is 20 minutes is :
(1) $\frac{1}{8}$ (2) $\frac{1}{32}$
(3) $\frac{1}{16}$ (4) $\frac{1}{9}$

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82. Initial decay rate of a substance is 800 disintegration/sec. If half life of substance is 1 sec. then after three second the decay rate will be :–
(1) 800 disintegration/sec.
(2) 400 disintegration/sec.
(3) 200 disintegration/sec.
(4) 100 disintegration/sec.

83. Plutonium - decays with a half life of 24000 years. If plutonium is stored for 72000 years, then the fraction of plutonium that remains, is
(1) 1/8 (2) 1/4 (3) 1/3 (4) 1/2

84. Which of the following radiations gets deflected by a magnetic field ?
(1) X-rays (2) γ-rays
(3) β-rays (4) radio waves

85. Fraction of tritium left after 125 years (half life of tritium is 12.5 years) is
(1) 1/1024 (2) 1/2048
(3) 1/4096 (4) 1/8192

86. α–Particles can be detected using :–
(1) Thin aluminium sheet
(2) Barium sulphate
(3) Zinc sulphide screen
(4) Gold foil

87. If half life period of radium is 1600 years then its average life is (approx) –
(1) 4200 years
(2) 3530 years
(3) 2300 years
(4) 2800 years

EXERCISE-I (Conceptual Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	3	3	2	4	4	2	2	3	2	4	2	3	4	1
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	1	4	1	1	2	2	1	4	1	1	4	1	4	3	3
Question	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Answer	3	1	3	2	1	2	2	4	1	1	1	3	3	4	3
Question	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Answer	1	2	2	2	2	1	3	3	2	3	4	4	1	2	4
Question	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Answer	2	4	1	4	2	4	1	2	1	3	4	3	2	2	3
Question	76	77	78	79	80	81	82	83	84	85	86	87			
Answer	1	3	3	1	4	1	4	1	3	1	3	3			

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Exercise - II (Previous Year Questions) AIPMT/NEET

AIPMT 2006

1. The binding energy of deutron is 2.2 MeV and that of ^4_2He is 28 MeV. If two deutrons are fused to form one ^4_2He then the energy released is :
(1) 25.8 MeV (2) 23.6 MeV
(3) 19.2 MeV (4) 30.2 MeV

2. The radius of Germanium (Ge) nuclide is measured to be twice the radius of ^9_4Be. The number of nucleons in Ge are :-
(1) 73 (2) 74 (3) 75 (4) 72

3. In a radioactive material the activity at time t_1 is R_1 and at a later time t_2, it is R_2. If the decay constant of the material is λ, then :
(1) $R_1 = R_2\, e^{-\lambda(t_1-t_2)}$ (2) $R_1 = R_2\, e^{\lambda(t_1-t_2)}$
(3) $R_1 = R_2\,(t_2/t_1)$ (4) $R_1 = R_2$

AIPMT 2007

4. If the nucleus $^{27}_{13}A\ell$ has a nuclear radius of about 3.6 fm, the $^{125}_{52}Te$ would have its radius approximately as :-
(1) 4.8 fm (2) 6.0 fm
(3) 9.6 fm (4) 12.0 fm

5. In radioactive decay process, the negatively charged emitted β - particles are :-
(1) the electrons orbiting around the nucleus
(2) the electrons present inside the nucleus
(3) the electrons produced as a result of the decay of neutrons inside the nucleus
(4) the electrons produced as a result of collisions between atoms

AIPMT 2009

6. The number of beta particles emitted by a radioactive substance is twice the number of alpha particles emitted by it. The resulting daughter is an-
(1) isotope of parent (2) isobar of parent
(3) isomer of parent (4) isotone of parent

7. In the nuclear decay given below :
$$^A_ZX \longrightarrow {}^A_{Z+1}Y \longrightarrow {}^{A-4}_{Z-1}B^* \longrightarrow {}^{A-4}_{Z-1}B,$$
the particles emitted in the sequence are :-
(1) α, β, γ (2) β, α, γ
(3) γ, β, α (4) β, γ, α

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AIPMT (Pre) 2010

8. The mass of a ^7_3Li nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of ^7_3Li nucleus is nearly :-
(1) 23 MeV (2) 46 MeV
(3) 5.6 MeV (4) 3.9 MeV

9. The activity of a radioactive sample is measured as N_0 counts per minute at t = 0 and N_0/e counts per minute at t = 5 minutes. The time (in minutes) at which the activity reduces to half its value is :-
(1) $5 \log_e 2$ (2) $\log_e 2/5$
(3) $\dfrac{5}{\log_e 2}$ (4) $5 \log_{10} 2$

AIPMT (Mains) 2010

10. The binding energy per nucleon in deuterium and helium nuclei are 1.1 MeV and 7.0 MeV, respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is :-
(1) 2.2 MeV (2) 28.0 MeV
(3) 30.2 MeV (4) 23.6 MeV

11. The decay constant of a radio isotope is λ. If A_1 and A_2 are its activities at times t_1 and t_2 respectively, the number of nuclei which have decayed during the time $(t_1 - t_2)$:-
(1) $A_1 - A_2$ (2) $(A_1 - A_2)/\lambda$
(3) $\lambda(A_1 - A_2)$ (4) $A_1t_1 - A_2t_2$

AIPMT (Pre) 2011

12. The power obtained in a reactor using U^{235} disintegration is 1000 kW. The mass decay of U^{235} per hour is :-
(1) 10 microgram (2) 20 microgram
(3) 40 microgram (4) 1 microgram

13. The half life of a radioactive isotope 'X' is 50 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio of 1 : 15 in a sample of a given rock. The age of the rock was estimated to be :-
(1) 150 years (2) 200 years
(3) 250 years (4) 100 years

14. A nucleus ${}^{m}_{n}X$ emits one α particle and two β^- particles. The resulting nucleus is :-

(1) ${}^{m-6}_{n-4}Z$ (2) ${}^{m-6}_{n}Z$

(3) ${}^{m-4}_{n}X$ (4) ${}^{m-4}_{n-2}Y$

AIPMT (Mains) 2011

15. Two radioactive nuclei P and Q in a given sample decay into a stable nucleus R. At time t = 0, number of P species are 4 N_0 and that of Q are N_0. Half-life of P (for conversion to R) is 1 minute where as that of Q is 2 minutes. Initially there are no nuclei of R present in the sample. When number of nuclei of P and Q are equal, the number of nuclei of R present in the sample would be :-

(1) $2N_0$ (2) $3N_0$

(3) $\frac{9N_0}{2}$ (4) $\frac{5N_0}{2}$

AIPMT (Pre) 2012

16. If the nuclear radius of ^{27}Al is 3.6 Fermi, the approximate nuclear radius of ^{64}Cu in Fermi is :

(1) 4.8 (2) 3.6 (3) 2.4 (4) 1.2

17. A mixture consists of two radioactive materials A_1 and A_2 with half lives of 20 s and 10 s respectively. Initially the mixture has 40 g of A_1 and 160g of A_2. The active amount of the two in the mixture will becomes equal after :

(1) 20s (2) 40s (3) 60s (4) 80s

AIPMT (Mains) 2012

18. The half life of a radioactive nucleus is 50 days. The time interval $(t_2 - t_1)$ between the time t_2 when 2/3 of it has decayed and the time t_1 when 1/3 of it had decayed is :-

(1) 60 days (2) 15 days

(3) 30 days (4) 50 days

NEET-UG 2013

19. A certain mass of Hydrogen is changed to Helium by the process of fusion. The mass defect in fusion reaction is 0.02866 u. The energy liberated per u is : (given 1u = 931 MeV)

(1) 13.35 MeV (2) 2.67 MeV

(3) 26.7 MeV (4) 6.675 MeV

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20. The half life of a radioactive isotope 'X' is 20 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio 1 : 7 in a sample of a given rock. The age of the rock is estimated to be:

(1) 100 years (2) 40 years

(3) 60 years (4) 80 years

AIPMT 2014

21. The Binding energy per nucleon of ${}^{7}_{3}Li$ and ${}^{4}_{2}He$ nuclei are 5.60 MeV and 7.06 MeV, respectively. In the nuclear reaction ${}^{7}_{3}Li + {}^{1}_{1}H \rightarrow 2\,{}^{4}_{2}He + Q$, the value of energy Q released is:-

(1) 19.6 MeV (2) –2.4 MeV

(3) 8.4 MeV (4) 17.3 MeV

22. A radio isotope 'X' with a half life 1.4×10^9 years decays to 'Y' which is stable. A sample of the rock from a cave was found to contain 'X' and 'Y' in the ratio 1 : 7. The age of the rock is :

(1) 1.96×10^9 years (2) 3.92×10^9 years

(3) 4.20×10^9 years (4) 8.40×10^9 years

AIPMT 2015

23. If radius of the ${}^{27}_{13}Al$ nucleus is taken to be R_{Al} then the radius of ${}^{125}_{53}Te$ nucleus is nearly :

(1) $\frac{5}{3}R_{Al}$ (2) $\frac{3}{5}R_{Al}$

(3) $\left(\frac{13}{53}\right)^{1/3} R_{Al}$ (4) $\left(\frac{53}{13}\right)^{1/3} R_{Al}$

RE-AIPMT 2015

24. A nucleus of uranium decays at rest into nuclei of Thorium and Helium. Then :-

(1) The Helium nucleus has less kinetic energy than the Thorium nucleus

(2) The Helium has more kinetic energy than the Thorium nucleus.

(3) The Helium nucleus has less momentum than the Thorium nucleus.

(4) The Helium nucleus has more momentum than the Thorium nucleus.

NEET-II 2016

25. The half-life of a radioactive substance is 30 minutes. The time (in minutes) taken between 40% decay and 85% decay of the same radioactive substance is :-

(1) 45 (2) 60 (3) 15 (4) 30

NEET(UG) 2017

26. Radioactive material 'A' has decay constant '8 λ' and material 'B' has decay constant 'λ'. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be e ?

(1) $\frac{1}{7\lambda}$ (2) $\frac{1}{8\lambda}$ (3) $\frac{1}{9\lambda}$ (4) $\frac{1}{\lambda}$

NEET(UG) 2018

27. For a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is :-

(1) 20 (2) 10 (3) 30 (4) 15

NEET(UG) 2019

28. α-particle consists of :

(1) 2 protons and 2 neutrons only
(2) 2 electrons, 2 protons and 2 neutrons
(3) 2 electrons and 4 protons only
(4) 2 protons only

NEET(UG) 2019 (Odisha)

29. The rate of radioactive disintegration at an instant for a radioactive sample of half life 2.2×10^9 s is 10^{10} s^{-1}. The number of radioactive atoms in that sample at that instant is,

(1) 3.17×10^{20} (2) 3.17×10^{17}
(3) 3.17×10^{18} (4) 3.17×10^{19}

NEET(UG) 2020

30. When a uranium isotope $^{235}_{92}U$ is bombarded with a neutron, it generates $^{89}_{36}Kr$, three neutrons and:

(1) $^{103}_{36}Kr$ (2) $^{144}_{56}Ba$ (3) $^{91}_{40}Zr$ (4) $^{101}_{36}Kr$

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31. The energy equivalent of 0.5 g of a substance is:

(1) 0.5×10^{13} J (2) 4.5×10^{16} J
(3) 4.5×10^{13} J (4) 1.5×10^{13} J

NEET(UG) 2020 (COVID-19)

32. What happens to the mass number and atomic number of an element when it emits γ-radiation?

(1) Mass number decreases by four and atomic number decreases by two.
(2) Mass number and atomic number remain unchanged.
(3) Mass number remains unchanged while atomic number decreases by one.
(4) Mass number increases by four and atomic number increases by two.

33. The half life of radioactive sample undergoing α-decay is 1.4×10^{17} s. If the number of nuclei in the sample is 2.0×10^{21}, the activity of the sample is nearly :

(1) 10^4 Bq (2) 10^5 Bq
(3) 10^6 Bq (4) 10^3 Bq

NEET(UG) 2021

34. A nucleus with mass number 240 breaks into two fragments each of mass number 120, the binding energy per nucleon of unfragmented nuclei is 7.6 MeV while that of fragments is 8.5 MeV. The total gain in the Binding Energy in the process is :

(1) 0.9 MeV (2) 9.4 MeV
(3) 804 MeV (4) 216 MeV

35. A radioactive nucleus $^{A}_{Z}X$ undergoes spontaneous decay in the sequence $^{A}_{Z}X \rightarrow {}_{Z-1}B \rightarrow {}_{Z-3}C \rightarrow {}_{Z-2}D$, where Z is the atomic number of element X. The possible decay particles in the sequence are :

(1) α, β^-, β^+ (2) α, β^+, β^-
(3) β^+, α, β^- (4) β^-, α, β^+

36. The half-life of a radioactive nuclide is 100 hours. The fraction of original activity that will remain after 150 hours would be :

(1) 1/2 (2) $\frac{1}{2\sqrt{2}}$ (3) $\frac{2}{3}$ (4) $\frac{2}{3\sqrt{2}}$

NEET(UG) 2022

37. In the given nuclear reaction, the element X is: $^{22}_{11}Na \rightarrow X + e^+ + \nu$

(1) $^{23}_{10}Ne$ (2) $^{22}_{10}Ne$ (3) $^{22}_{12}Mg$ (4) $^{23}_{11}Na$

38. A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is:

(1) 4 : 5 (2) 5 : 4

(3) 25 : 16 (4) 1 : 1

RE-NEET(UG) 2022

39. Given below are two statements :

Statement I :

The law of radioactive decay states that the number of nuclei undergoing the decay per unit time is inversely proportional to the total number of nuclei in the sample.

Statement II :

The half life of a radionuclide is the sum of the life time of all nuclei, divided by the initial concentration of the nuclei at time t = 0.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but Statement II is incorrect

(4) Statement I is incorrect but Statement II is correct

40. At any instant, two elements X_1 and X_2 have same number of radioactive atoms. If the decay constant of X_1 and X_2 are 10 λ and λ respectively. then the time when the ratio of their atoms becomes $\frac{1}{e}$ respectively will be :

(1) $\frac{1}{11\lambda}$ (2) $\frac{1}{9\lambda}$

(3) $\frac{1}{6\lambda}$ (4) $\frac{1}{5\lambda}$

EXERCISE-II (Previous Year Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	2	4	1	2	3	1	2	3	1	4	2	3	2	3	3
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	1	2	4	4	3	4	3	1	2	2	1	1	1	4	2
Question	31	32	33	34	35	36	37	38	39	40					
Answer	3	2	1	4	3	2	2	2	2	2					

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Exercise - III (Analytical Questions) Master Your Understanding

1. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**
Assertion (A) : Radioactive nuclei emits β^-particle.
Reason (R) : Electrons exist inside the nucleus
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

2. Match the following

	List-I		List-II
a	$n \rightarrow p +$	(p)	α–decay
b	$p \rightarrow n +$	(q)	Positron emission
c	x–ray emission	(r)	β^-emission
d	$^{226}_{88}Ra \rightarrow ^{222}_{86}Rn +$ ___	(s)	K electron capture

(1) $a \rightarrow r, b \rightarrow q, c \rightarrow q, d \rightarrow s$
(2) $a \rightarrow q, b \rightarrow r, c \rightarrow s, d \rightarrow p$
(3) $a \rightarrow r, b \rightarrow q, c \rightarrow s, d \rightarrow p$
(4) $a \rightarrow q, b \rightarrow s, c \rightarrow r, d \rightarrow p$

3. Given blow are two statements:
Statement I : Two different radioactive substances have initially same number of nuclei. Their decay constants are λ_1 and λ_2 ($<\lambda_1$). Then first radioactive substance decays with faster rate initially.
Statement II : Half life of first radioactive substance is lesser than second.
In light of above statement choose the most **appropriate** answer from the options given below:
(1) Both statement I and statement II are correct.
(2) Statement I is correct and statement II is incorrect.
(3) Statement I is incorrect and statement II is correct.
(4) Both statements I and statements II are incorrect.

4. When a nucleus with atomic number Z and mass number A undergoes a radioactive decay process:
(A) both Z and A will decrease if the process is α– decay
(B) Z will decrease but A will not change if process is β^+ decay
(C) Z will decrease but A will not change if process is β^- decay.
(D) Z and A will remain unchanged if process is γ–decay.
Choose the correct statement :
(1) Only A (2) B, C, D
(3) A, D (4) A, B, D

5. Choose correct statement/statements :
(a) Nuclear force is independent of charge of nucleons.
(b) Nuclear force has saturation property.
(c) Nuclear force is always Attractive is nature.
(d) Nuclear force exists in range of femtometre.
(1) a,b,c (2) a,b,d (3) b,c,d (4) a, c, d

6. Match the following column:
For two nuclei having mass number 2 and 16

(i) Ratio of nuclear radii	(p) 1 : 8
(ii) Ratio of densities	(q) 1 : 2
(iii) Ratio of volumes	(r) 1 : 1
(iv) Ratio of masses	(s) 1 : 8

(1) (i) $\rightarrow$ q, (ii) $\rightarrow$ r, (iii) $\rightarrow$ s, (iv) $\rightarrow$ p
(2) (i) $\rightarrow$ r, (ii) $\rightarrow$ s, (iii) $\rightarrow$ p, (iv) $\rightarrow$ q
(3) (i) $\rightarrow$ p, (ii) $\rightarrow$ q, (iii) $\rightarrow$ r, (iv) $\rightarrow$ s
(4) (i) $\rightarrow$ r, (ii) $\rightarrow$ p, (iii) $\rightarrow$ s, (iv) $\rightarrow$ q

7. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**
Assertion (A) : Fission reactions are exothermic
Reason (R) : Total mass of fragments is lesser than the total mass of reactants.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

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8. Given below are two statements
Statement I : Binding energy per nucleon is more important than binding energy.
Statement II : Binding energy per nucleon is measurement of nuclear stability.
In light of above statement choose the most **appropriate** answer from the options given below:

(1) Both statement I and statement II are correct.
(2) Statement I is correct and statement II is incorrect.
(3) Statement I is incorrect and statement II is correct.
(4) Both statements I and statements II are incorrect.

EXERCISE-III (Analytical Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8
Answer	3	3	1	4	2	1	1	1

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